

GEOLOGY OF SOUTH-WESTERN  
NOVA SCOTIA.

A REPORT, by Dr. L. W. Bailey, dealing with the geology of a portion of the Province of Nova Scotia, appears in the annual report of the Geological Survey of Canada (vol. ix., 1896), just issued. Until recently, but little was known of the geology of this region; indeed, the only important references thereto are those contained in the "Acadian Geology" of Sir Wm. Dawson, and these were almost wholly confined to the seaboard. The interior, being essentially unfit for settlement and difficult of access, received little or no attention until, in the year 1891, as a consequence of the interest aroused in gold mining, something like a systematic survey was begun. The results of this exploration, extending over several years and including four counties, with portions of a fifth, are contained in the volume just published.



Glacier-ploughed trough in Cambrian Rocks, Lockport Island, Nova Scotia.

Of the formations described, that occupying the largest area is granite, but this, instead of being represented, as in previous descriptions, as simply forming a belt of uniform width and constituting the axis of the peninsula, is shown to possess an exceedingly irregular contour, besides being disclosed either by extrusion or denudation in many detached areas. Enwrapping the granite, but along the lines of contact invaded by the latter in the most complicated way, are the rocks usually styled the "Nova Scotia gold series." These are also styled Cambrian, though it is stated that as yet no positive proof that such is their age has been obtained. The rocks appear to be essentially non-fossiliferous, and by some authors are regarded as being Pre-Cambrian. They consist of three principal members, of which the lowest and chief one is composed of heavy beds of quartzite alternating with slates, the second of argillites which are often parti-coloured, and third of black slates, usually highly charged with pyrites. Their thickness is very great, certainly

10,000 feet, and probably much more than this. Ridged up by pressure from the Atlantic side, but at the same time affected by strains more or less transverse to the trend of the coast, they present a series of dome-like folds, varying from nearly circular to elliptical or linear in outline, of which the centre is usually composed of quartzites and the encircling beds black or coloured slates. It is in connection with these domes or anticlines that the principal dislocations have been determined, and, on account of their intimate connection with the development of gold veins, have received much attention and are somewhat minutely described. Quite a number of mines exist within the area considered, and some of them are yielding large returns. In the neighbourhood of the granite the Cambrian rocks are greatly altered, but gold veins are comparatively few in connection with the more highly metamorphosed strata.

In addition to the supposed Cambrian rocks there are, in Digby and Annapolis counties, considerable areas occupied by more recent rocks, viz. Eo-Devonian and Triassic. These are confined to the neighbourhood of the Bay of Fundy, the former containing large numbers of fossils of about the age of the Oriskany sandstones of New York, and the latter wholly unfossiliferous, embracing red sandstones in the Annapolis Valley and traps in the North Mountains, which overlook the latter from the northern side.

The region presents many features of interest as regards its superficial geology, the most striking being the numerous fiord-like indentations of the coast, the great numbers and large size of the erratics with which the surface is strewed, the occurrence of kames, or horse-backs, in some instances thirty miles in length, and the evidences afforded on the coast of deep glacial ploughings. One striking instance of this is given in the accompanying photograph—but others, of much greater depth and breadth, have been observed.

The report is accompanied by a coloured map, on which, in addition to the separation of the various rock-formations, the more important "Domes" and gold districts are clearly indicated.

SCIENTIFIC WORK OF THE U.S. DEPARTMENT  
OF AGRICULTURE.<sup>1</sup>

## WEATHER BUREAU.

ARRANGEMENTS have been made to establish stations for making meteorological observations and displaying hurricane signals at Kingston, Santiago de Cuba, Santo Domingo, St. Thomas, Barbados, Dominica, Trinidad, Curaçao, and Barranquilla.

When the West Indian service is fully established twice-daily reports will be received, not only from the stations named, but also from Habana, Nassau, Vera Cruz, Tampico, Coatzacoalcas, and Merida. The improved storm-warning service will largely benefit the commercial interests throughout the West Indies.

The Central Meteorological and Magnetic Observatory of Mexico has begun the equipment of about thirty stations in the Mexican Republic, with the most approved meteorological instruments, and will establish a meteorological service similar to our own. When completed, an exchange of reports, especially those relating to the approach of West Indian hurricanes and "northers" in the Gulf of Mexico, will be effected.

Aerial observations by means of kites were continued during the year. It was hoped to establish at least twenty stations, but it was found that only sixteen could be completely equipped. It is too early to express an opinion regarding the value of the observations already secured in the aerial work of the Bureau.

The importance of the study of meteorology in the United States has been kept in mind, especially in the assignment of observers to duty at points where there are colleges or universities not already provided with instructors in meteorology, and during the past year the courses in meteorology have been strengthened in a large number of high schools and academies.

The Bureau has begun the collection of statistics of loss to farm property, including live stock in the fields, by lightning, so as to determine the frequency of lightning stroke and the amount of property destroyed annually by that phenomenon.

## VEGETABLE PHYSIOLOGY AND PATHOLOGY.

The work of this Division is carried on with a view of obtaining additional light on the conditions governing the growth and

<sup>1</sup> Extracted from the Report on the work of the U.S. Department of Agriculture for the year ending June 30, 1898.

production of cultivated plants, with special reference to diseases, nutrition, and development of new and improved sorts by breeding and selection.

During the year valuable knowledge was obtained relative to increasing the sugar and starch-producing power of plants, and the effect of soil foods on their growth and productiveness.

The work of hybridising the sweet orange with the hardy trifoliolate, with a view of obtaining a variety resistant to cold, was pushed on, and about one hundred and fifty hybrids obtained. In addition to this about one thousand hybrids of other citrus plants were obtained. Considerable work was done in crossing pineapples, and as a result two hundred and fifty-nine hybrid seedlings were secured. These produced plants of great vigour, and confirmed the belief that by this means there may be produced fruits which will be larger, of better quality, better shippers, and more resistant to blight. Similar work was carried on with pears and with wheat and other crops.

#### BIOLOGICAL SURVEY.

With a view to determining the areas best adapted for various crops, the Biological Survey has been engaged for several years in collecting data for mapping the natural life zones of the United States. A detailed study of the distribution of the native animals and plants has been made in the belief that areas inhabited by indigenous species coincide with those most suitable for certain varieties of fruit and cereals and for breeds of domesticated animals. This investigation has now progressed far enough to permit the publication during the past year of a revised map of the life zones of the United States and two reports containing the results of more general interest to farmers and horticulturists.

One of these reports comprised a description of the life zones and crop zones of the United States, with lists of the more important varieties of fruits and grains adapted to each area; the other, an investigation of the geographic distribution of some of the more important cereals.

The Biological Survey is often called upon to determine the value of birds and animals to practical agriculture. A careful study is made of the food of useful and injurious birds and mammals, and thousands of stomachs of birds are examined in the laboratory. Two thousand three hundred and twenty-nine stomachs, mainly of sparrows, swallows and woodpeckers, were examined during the year. A report has been published on the native cuckoos and shrikes (see p. 61), and reports on flycatchers and native sparrows are in preparation. Several of the latter birds feed largely on weed seed during the winter, and it is a matter of no little interest to determine how far they can aid the farmer in checking the increase of noxious weeds. The importance of this work is emphasised by the increasing demand made on the Department for information and publications on birds, in consequence of the recent widespread popular interest in ornithology.

#### FORESTRY.

At the end of the fiscal year the creation of the New York State College of Forestry and the election of Mr. B. E. Fernow to the directorship created a vacancy in the position of Chief of the Division, which Mr. Fernow held for twelve years, and Mr. Gifford Pinchot, of New York, was appointed his successor.

One of the most useful lines of work has been an investigation of the forest conditions of the State of Wisconsin, in co-operation with the State Geological Survey (see p. 82).

The accumulated data of the investigations in timber physics has been worked out in part and yielded some most important results, among which the law that the strength of a beam at the elastic limit is equal to the compression strength of the material, which was established by the tests of the Division, will influence the practice in the use of wood for construction most advantageously.

#### AGROSTOLOGY.

Through the efforts of this Division the needs of the several sections of the United States are being determined, and the forage problems which they have to meet are being found. The work leads to a better knowledge of the distribution and value of the native grasses and forage plants, as well as the peculiar conditions of soil and climate best suited to their growth. More than 500 varieties of grasses and forage plants valued for forage have been grown in the grass garden on the grounds of the Department during the past season.

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Over 5000 specimens of American grasses have been identified during the year, and nearly 3000 sheets of herbarium specimens mounted and added to the National Herbarium. The grass collection now in the Department numbers over 30,000 sheets.

#### SOILS.

Records have been continued of the moisture content of some of the principal soil areas in the country with the electrical method of moisture determination. As the soil is the immediate source of the water supply of plants, this record becomes an essential part of climatology, and it seems probable that this work of the Division of Soils, in connection with the present work of the Weather Bureau and of the Division of Statistics, will develop a distinctively new line of agricultural climatology. This work is closely related to the work of the Weather Bureau, but is supplementary to it. It includes the record of evaporation to which the plant is subjected, the water supply maintained by the soil for supplying the loss due to this evaporation, and the intensity of the actinic and heat radiations which influence the physiological activities of the plant. Numerical values can be given to the evaporation and to the soil-moisture conditions, so that it is possible to express numerically the relative conditions of plant growth from day to day so far as these two important factors of evaporation and water supply are concerned. This will add greatly to the practical value of our knowledge of climatology.

Among the most important lines of work which the Department can take up for the tobacco grower is the study of the diseases in the tobacco bed and the comparatively few diseases in the field, and particularly the study of curing and fermentation. A large amount of research work has been done, particularly in Germany, in the fermentation of tobacco, but very little is yet known of the changes which go on in the process or regarding the specific agents which bring about these changes. So much information and practical benefit have been derived from a study of butter and cheese, in the control of the ferments and bacteria which produce the texture and flavour of the product, that it is very desirable that similar knowledge in the curing and fermentation of tobacco, and similar control of the finished product, should be secured. This work will require very careful study of the changes in the fermentation pile in the different tobacco districts.

If American tobacco growers are to attempt to raise a product equal to that of Cuba and Sumatra, and if this is to be done not by chance, but through systematic, scientific investigations, then the soils and other conditions of growth must be thoroughly understood, and the fermentation changes carefully worked out in Cuba and Sumatra. It is necessary, therefore, that a soil expert and a bacteriologist extend their work to these foreign countries.

#### BOTANY.

The Division of Botany is at work to reduce the importations into the United States of the little things that have been costing the Americans 8,000,000 dollars annually. Western States are now growing chicory. In 1896 16,317,888 pounds were imported, in 1898 only 315,707 pounds of raw chicory were imported. The farmers of Michigan, Nebraska, and other States will now furnish the supply. Ginseng is also a promising plant for cultivation. The Division of Botany will make tests to protect farmers and merchants against foul and fraudulently imported seeds, and test the importations of the Department before distribution.

The distribution of young plants to various parts of the country was continued during the year, reaching a total of nearly 190,000, including bulbs. Among these were olive, fig, and camphor plants and cuttings. Attention is called to the fact that the growing of rubber plants, even in the most favourable localities of Florida, can hardly be commercially successful.

#### EXPERIMENT STATIONS.

The annual grant of 720,000 dollars for the agricultural experiment stations is supplemented by 400,000 dollars from the States. About four hundred reports and bulletins were issued by the stations in 1897, which were directly distributed to over half a million addresses.

The need and value of scientific researches on behalf of agriculture are now very clearly understood, and the number and importance of institutions organised for this work are constantly increasing in all parts of the world. Nowhere has so

comprehensive and efficient a system of experiment stations been established as in the United States. In the scope and amount of their operations, and in the thoroughness with which the useful information they obtain is disseminated among the farmers, the stations are unsurpassed.

The stations are not the only means for the education of the farmer. Agricultural colleges, farmers' institutes, boards of agriculture, and various other agencies have been established to instruct the farmer regarding the present status of agricultural science as applied to his art. It is the business of the experiment stations, on the other hand, to advance knowledge of the facts and principles underlying successful agriculture, and to teach the farmer new truths made known by their investigations. The act of Congress creating the stations clearly defines their functions to be the making and publishing of original investigations. Wherever a station has neglected this, and merely endeavoured to educate the farmer, we find a weak station, and wherever a station has earnestly devoted itself to original investigations, we find a strong station. The station may very properly lend its influence to strengthening the influence and work of the educational agencies established for the farmers' benefit, but it fails to fulfil its real mission when it resolves itself into a bureau of information, or devotes a large share of its energies to the compilation of popular treatises on agriculture. It is gratifying to observe that the original investigations at the stations are increasing in number and improving in quality.

The movement for the extension and popularisation of agricultural instruction is growing in importance. The short and special courses in the colleges, the farmers' institutes, and the home-reading circles are attracting larger numbers of farmer students. The effort to introduce nature teaching, largely on subjects relating to agriculture, is being actively prosecuted in several States.

The investigations upon the "nutritive value of various articles and commodities used for human food" have been pursued as hitherto, in co-operation with agricultural colleges and experiment stations and other educational institutions. Special investigations with the respiration calorimeter have been made, in which not only the nutritive value of the food consumed but also its relation to the heat and energy evolved by the human body during periods of rest and work have been measured with a completeness and accuracy hitherto unknown. These investigations are not only of very high scientific importance, but have also already given promise of useful practical application. The results of the careful studies of the dietaries of people of different occupations, made in connection with the nutrition investigations, have been widely republished.

It is believed that the nutrition investigations of the Department have already done much to establish a scientific basis for the courses of instruction on the food and nutrition of man, which are rapidly increasing in number and importance throughout the country.

#### PRACTICAL EXPERIMENTS IN NATURE TEACHING UNDER STATE AUTHORITY.

In New York, the College of Agriculture of Cornell University has a special State grant of 25,000 dollars per annum to be used in aiding the introduction of nature teaching into the common schools and the carrying on of simple agricultural experiments in different parts of the State. The plan followed has been to employ experts in the different sciences to prepare brief leaflets containing lessons on various subjects for the use of teachers in the common schools. These leaflets are distributed to teachers throughout the State, and there has been such a large demand for them from teachers in other States that arrangements have been made to sell them at a nominal price.

The professors and other agents of the university attend meetings of teachers from time to time, to explain the scope of this work and to show the teachers how to carry out simple instruction on nature topics. Many of these leaflets relate directly to agricultural subjects. For example, in one leaflet the teacher is instructed to have the children plant squash seeds, take some of them up at intervals to learn how the seeds germinate, and watch what happens to the little plants as they grow. At another time the children are encouraged to plant little gardens and carefully watch some of the things that grow in them; or they study some insect which preys upon fruit, or make collections of the insects about their homes, or watch them to see whether they are doing things good or bad for the farmer. This movement has rapidly increased in popularity, and the leaflets

are used in many city schools as well as in those in the country. Hundreds of simple experiments with fertilisers on potatoes have been carried on in different parts of the State with some of the money above referred to. For carrying on all this work the university has employed its teaching force and a small corps of special agents and clerks.

In Indiana, Purdue University has undertaken a similar work, though its funds have not permitted it to make it very extensive. A number of leaflets have been prepared by different members of the faculty, and have been sent out to teachers throughout the State. In a number of other States nature teaching has been introduced into the common schools, but for the most part in the schools in the larger towns and cities, where there were teachers who had had some training in natural science. As a result of the widespread interest in this subject, teachers' manuals and text-books for instruction in this branch are being prepared.

#### ANIMAL DISEASES.

The Bureau has continued experimentation with antitoxin serum for the prevention and cure of hog cholera. Congress, at its last session, made a grant in aid of this work, which became available at the beginning of the present fiscal year. Buildings were erected at an experiment station, and animals purchased to make the serum in sufficient quantities to conduct extensive research. The results of the previous year have been corroborated. Eighty per cent. of the animals treated were saved, while a like per cent. of the check herds not treated died. This justifies the Department in efforts to supply in future to herdsmen throughout the country such serum as can be made. It is for Congress to determine whether serum shall be given free or a charge be made covering the expense of manufacture, which would be about fifteen cents for each animal.

The study of tuberculosis, with reference to both men and animals, has been continued, and the results so far obtained indicate that experiments already begun in this line should be continued, as there is a prospect of more satisfactory results.

Experiments in dipping cattle to kill the ticks which cause Texas fever were continued, with the gratifying result that a substance has been found which will destroy all the ticks on an animal at a single dipping, and will not injure the animal.

#### CHEMISTRY.

The Division of Chemistry during the past year has continued its work on the composition and adulteration of foods. An elaborate bulletin, treating of the composition of cereals and all cereal products, represents the results of the principal amount of work in this direction. Another bulletin is devoted to the composition and uses of Indian corn, and this bulletin was prepared especially for presentation at the third International Congress of Applied Chemistry in Vienna, which met in July 1898.

The Division continued during the year its investigations of the possibilities of producing high-grade sugar beets in various parts of the United States. As a result of the extensive chemical studies conducted, the area suitable to the production of the best beets has been more definitely delineated. A few years more of studies of this kind will mark out in a practical manner the areas where beets of the highest grade can be produced.

#### ENTOMOLOGY.

General investigations have been carried on in this Division through the year upon insects injurious to garden crops, to shade trees, and to citrus trees and fruit. The general experimental work, with remedies, has comprised especially careful investigations of the availability of hydrocyanic acid gas in the disinfection of seeds in bulk and of plants and nursery material, and further experiments with arsenicals and various oil mixtures in order to determine their effects on plants in dormant condition and in foliage.

A preliminary attempt has been made to introduce from Southern Europe into California an insect which is responsible for the fertilisation of the Smyrna figs of commerce. The Entomologist visited California in the spring of 1898, and found that conditions were ripe for such an attempted introduction, and an agent in Europe will, during the coming year, endeavour to take the necessary steps to bring about this introduction, which, it is hoped, will result in the production by California of a fig equal to the Smyrna fig.

A successful importation has been made of an important parasite of certain large scale insects.

Other important work carried on under this Division during the year has included the sending successfully of beneficial species to foreign Governments suffering from outbreaks of the white or fluted scale, the preparation of an account of the work accomplished during the past two years against the San José scale, an investigation of the injurious grasshoppers of the Western States, work upon remedies to be used against the house fly, suggested by the growing belief in the importance of this insect as a carrier of disease; work upon the geographic distribution of injurious insects of the United States, and experimental work in agriculture.

### UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Board of Electors will meet on February 11 for the purpose of electing a successor to the late Professor of Pathology, Dr. Kanthack. Candidates are to send their names to the Vice-Chancellor on or before February 4.

The Clerk Maxwell Studentship in Experimental Physics has been awarded to Mr. J. S. E. Townsend, of Trinity College.

AT a meeting in Birmingham, last week, of the Court of Governors of Mason University College, Mr. Chamberlain, in his capacity of president of the College, occupied the chair. In the course of his remarks, Mr. Chamberlain mentioned that the endowment fund of the proposed University of Birmingham had made very considerable progress, and that further assistance was to be expected from the leading managers and directors of the great limited liability firms, who were inclined to take a proper view of their responsibilities and obligations in a question upon which the future of the city so largely depended. Referring in more detail to the University scheme, Mr. Chamberlain emphasised the importance of establishing a faculty of commerce in connection with the curriculum. "Whilst," he remarked, "we shall always hope that in the University the highest culture will receive its due attention, still I think it important, to justify our separate existence, that we should have distinctive features in our curriculum, and nowhere shall we find that better than in such a faculty of commerce." Mr. Chamberlain's ambition is that in the future the business men of Birmingham and the district who enjoy a fair social position will not consider themselves properly equipped for their career without having obtained a degree in the University faculty of commerce.

THE annual meeting of the Geographical Association was held on Wednesday, January 11. As already stated (p. 238), the Association was founded in 1893, and its aim is to raise geography as a school subject from its present low level in secondary schools by spreading the knowledge of all such methods of geographical teaching as bring into play the pupil's intelligence and reasoning powers, instead of merely loading the memory with names and isolated facts. A memorial to boards of public examiners on the subject of reforms in examinations in geography has already, in many cases, led to a marked improvement in the character of the questions set. Amongst other means adopted by the Association for the furtherance of its aim, are lectures and meetings for discussion; the adoption of the *Journal of School Geography* as a medium for the publication of information of service to teachers of geography; and the circulation of lantern slides (maps, diagrams, and views of scenery). The question of a syllabus has been before the Association for some time, but the Committee are unwilling to lend their authority to any definite scheme of work, preferring rather to encourage individual teachers to explain in detail their own ideas of method, the outcome of their own practical experience. Mr. Douglas W. Freshfield, the president of the Association, delivered a short address at the annual meeting, and in the course of his remarks he referred to points dealt with in the report, and commended the decision of the Committee in not insisting upon any particular form of syllabus.

A CONFERENCE on science teaching in connection with the Technical Education Board of the London County Council was held, under the direction of Dr. Kimmins, at the South-West London Polytechnic, on January 12 and 13. The following papers occupied the morning of January 12:—"The Teaching of Optics," by Mr. Sanderson, headmaster of Oundle School; "The Method of Teaching Science," by Mr. Frank Weedon,

of Alleyn's School, Dulwich. Dr. Garnett presided. In the afternoon Miss Edna Walter, of the Central Foundation School for Girls, and Mr. Burkhardt, of Owen's School, Islington, read papers on "The Teaching of Chemistry." Prof. Armstrong occupied the chair. At the third meeting Mr. S. H. Wells, Principal of the Battersea Polytechnic, and Mr. S. Whalley, of Simon Langton School, Canterbury, read papers on "The Teaching of Elementary Mechanics in Schools." Prof. Hudson Beare presided. At the fourth meeting, papers on "The Teaching of Heat," by Mr. Arthur Adamson, of the Central Higher Grade School, Manchester; and on "Magnetism and Static Electricity," by Dr. T. Buchanan, of Gordon College, Aberdeen, took up the attention of the meeting. Prof. Ewing presided. It is much to be hoped that this very successful experiment will be repeated next year. The attendance at each meeting was large, and included, in addition to many science teachers from all parts of the country, several of the inspectors of the Science and Art Department, and such well-known men of science as Dr. Gladstone and Captain Abney. Enthusiastic discussions followed each paper, and the number of practical hints which were to be gleaned at each meeting well repaid attendance. The collection of apparatus, specially designed for use in schools, which Dr. Kimmins had got together and had arranged in the physical, chemical and mechanical laboratories, should do a great deal in the direction of acquainting science masters with what other teachers are doing. Many of the exhibits were original, and highly ingenious.

AT a meeting of Convocation of the University of London, held on Monday, it was resolved:—"That, in the opinion of this house, the new regulations for the matriculation examination tend to discourage the study of modern languages in schools, by making them entirely optional and alternative to science." The following resolution was referred to the standing committee:—"That the examination in general elementary science should be restricted to the first part of the subject, and comprised in one paper; the second part to be made optional with the other sciences, and a third language to form a separate and obligatory section taking its place."

AT the annual general meeting of the Headmasters' Association, on Friday last, the following resolutions were adopted: (1) "That this Association cordially welcomes the Board of Education Bill as a first step towards the organisation of secondary education in England, and is of opinion that the consultative committee proposed therein ought to be permanent and to contain representatives of the Universities and of bodies of teachers." (2) "That this Association records with satisfaction the statement made by the Lord President in introducing the Board of Education Bill—viz. that the proposed Education Office would probably be so organised as to consist of three departments, dealing with primary, secondary, and technical education respectively."

THE Association of Technical Institutions held its annual conference in London on Thursday last. Lord Spencer was elected president for the ensuing year, and delivered an address, on which he dwelt on the extreme importance of improved technical education in the interests of our commerce and industry, and indicated some of the more pressing reforms that were needed. The following resolution was afterwards carried:—"That the Association desires to place on record its appreciation of the Board of Education Bill, 1898, as a first instalment of legislation on the lines recommended by the recent Royal Commission, and its hope that the Government may see its way to proceed further in the same direction."

THE Association of Directors and Organising Secretaries for technical and secondary education held its annual meeting on Friday last, Mr. H. Macan presiding. The chief subject discussed was the Government Secondary Education Bill, and the constitution of the proposed local authority to be responsible for technical and secondary education. It has already been agreed among the bodies interested that on the new local education authorities the County Council should have half the representation, and the School Boards a third, the remainder being made up of co-opted members. At Friday's meeting, some hostility was shown towards the proposal to give School Boards so large a representation as a third, or even any at all, the opinion being expressed that the present powers possessed by County Councils are sufficient to secure the representation of all educational interests in the areas of administrative counties. Among the resolutions agreed to was one expressing the view